

Product Specification

SPECIFICATION FOR APPROVAL

(●) Preliminary Specification

() Final Specification

Title	47.0" WUXGA TFT LCD
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BUYER	AmTRAN
MODEL	

SUPPLIER	LG.Display Co., Ltd.
*MODEL	LC470DUS
SUFFIX	SCM1 (RoHS Verified)

*When you obtain standard approval,
please use the above model name without
suffix

APPROVED BY	SIGNATURE	DATE
/		
/		
/		

Please return 1 copy for your confirmation with
your signature and comments.

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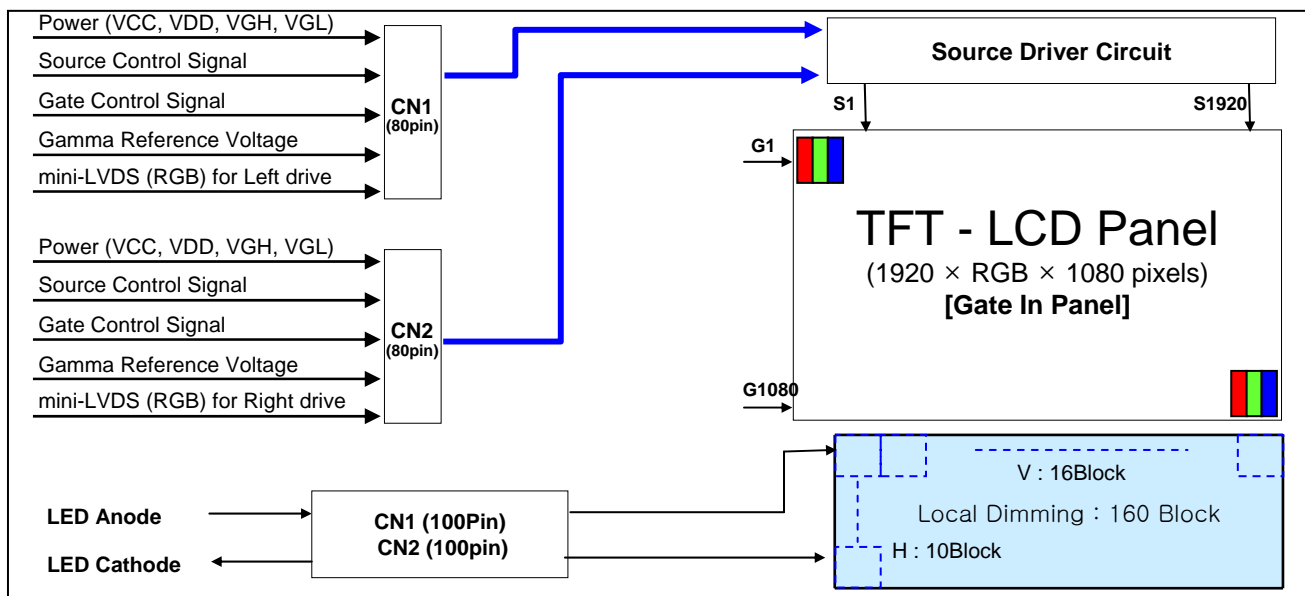
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Product Specification

1. General Description

The LC470DUS is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (LED) Local Dimming backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally black mode. It has a 46.96 inch diagonally measured active display area with WUXGA resolution (1080 vertical by 1920 horizontal pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the luminance of the sub-pixel color is determined with a 10-bit gray scale signal for each dot. Therefore, it can present a palette of more than 1.06B(FRC) colors.

It is intended to support LCD TV, PCTV where high brightness, super wide viewing angle, high color gamut, high color depth and fast response time are important.



General Features

Active Screen Size	46.96 inches(1192.87mm) diagonal
Outline Dimension	1096.0(H) x 640.0 (V) x 35.5 mm(D) (Typ.)
Pixel Pitch	0.5415 mm x 0.5415 mm
Pixel Format	1920 horiz. by 1080 vert. Pixels, RGB stripe arrangement
Color Depth	8-bit, 16.7M colors (* 1.06B colors @10bit (D) System Output)
Drive IC Data Interface	Source D-IC : 8-bit mini-LVDS, gamma reference voltage, and control signals Gate D-IC : Line on Glass(LOG) Through Source D-IC
Luminance, White	500 cd/m ² (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total TBDW (Typ.) (Logic=8.76 W, LED Backlight =TBDW)
Weight	13Kg (Typ.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-reflection treatment of the front polarizer (Reflectance : 2%)

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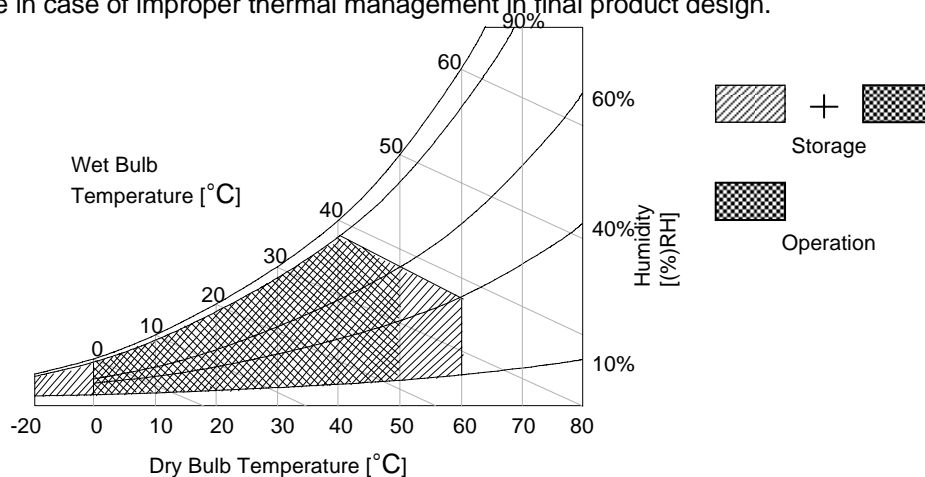
2. Absolute Maximum Ratings

The following items are maximum values which, if exceeded, may cause faulty operation or damage to the LCD module.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value		Unit	Note
		Min	Max		
Logic Power Voltage	VCC	-0.5	+4.0	V _{DC}	1
Gate High Voltage	VGH	+18.0	+30.0	V _{DC}	
Gate Low Voltage	VGL	-8.0	-4.0	V _{DC}	
Source D-IC Analog Voltage	VDD	-0.3	+18.0	V _{DC}	
Gamma Ref. Voltage (Upper)	VGMH	$\frac{1}{2}VDD-0.5$	$VDD+0.5$	V _{DC}	
Gamma Ref. Voltage (Low)	VGML	-0.3	$\frac{1}{2} VDD+0.5$	V _{DC}	
LED Input Voltage	V _F	-	13.6	V _{DC}	
Panel Front Temperature	T _{SUR}	-	+68	°C	4
Operating Temperature	T _{OP}	0	+50	°C	2,3
Storage Temperature	T _{ST}	-20	+60	°C	
Operating Ambient Humidity	H _{OP}	10	90	%RH	
Storage Humidity	H _{ST}	10	90	%RH	

- Note:
1. Ambient temperature condition ($T_a = 25 \pm 2 \text{ }^\circ\text{C}$)
 2. Temperature and relative humidity range are shown in the figure below. Wet bulb temperature should be Max 39 °C and no condensation of water.
 3. Gravity mura can be guaranteed below 40 °C condition.
 4. The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 68 °C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 68 °C. The range of operating temperature may degrade in case of improper thermal management in final product design.



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3. Electrical Specifications

3-1. Electrical Characteristics

It requires several power inputs. The VCC is the basic power of LCD Driving power sequence, Which is used to logic power voltage of Source D-IC and GIP.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Condition	MIN	TYP	MAX	Unit	Note
Logic Power Voltage	VCC	–	3.0	3.3	3.6	V _{DC}	
Logic High Level Input Voltage	V _{IH}		2.3		VCC	V _{DC}	
Logic Low Level Input Voltage	V _{IL}		0		0.8	V _{DC}	
Source D-IC Analog Voltage	VDD	–	16.3	16.5	16.7	V _{DC}	
Half Source D-IC Analog Voltage	H_VDD	–	8.05	8.25	8.45	V _{DC}	
Gamma Reference Voltage	V _{GMH}	(GMA1 ~ GMA9)	$\frac{1}{2} \times VDD$		VDD-0.2		
	V _{GML}	(GMA10 ~ GMA18)	0.2		$\frac{1}{2} \times VDD$		
Common Voltage	V _{com}	–	5.9	6.2	6.5	V	
Mini-LVDS Clock frequency	CLK	3.0V ≤ VCC ≤ 3.6V			312	MHz	
mini-LVDS input Voltage (Center)	V _{IB}	Mini-LVDS Clock and Data	0.7 + (V _{ID} /2)		(VCC-1.2) – V _{ID} / 2	V	5
mini-LVDS input Voltage Distortion (Center)	ΔV _{IB}				0.8	V	
mini-LVDS differential Voltage range	V _{ID}		150		800	mV	
mini-LVDS differential Voltage range Dip	ΔV _{ID}		25		800	mV	
Gate High Voltage	V _{GH}		26.7	27.0	27.3	V _{DC}	
Gate Low Voltage	V _{GL}		-5.2	-5.0	-4.8	V _{DC}	
Gate High Modulation Voltage	V _{GHM}	–	–	19	–	V _{DC}	Fig.1
Total Power Current	I _{LCD}	–	–	1010	1315	mA	1,2
Total Power Consumption	P _{LCD}	–	–	12.1	15.8	Watt	

- Note: 1. The specified current and power consumption are under the V_{LCD}=12V., 25 ± 2°C, f_v= 240Hz condition whereas mosaic pattern(8 x 6) is displayed and f_v is the frame frequency.
 2. The above spec is based on the basic model.
 3. All of the typical gate voltage should be controlled within 1% voltage level
 4. Ripple voltage level is recommended under 10%
 5. In case of mini-LVDS signal spec, refer to Fig 2 for the more detail.

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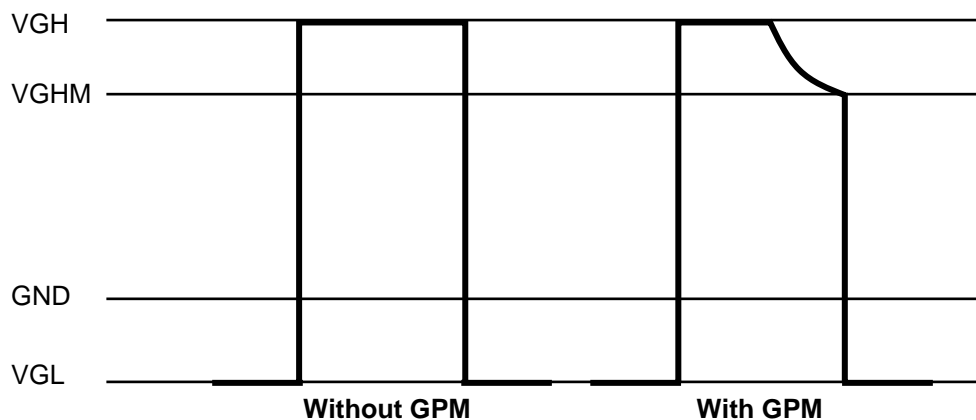


FIG. 1 Gate Output Wave form without GPM and with GPM

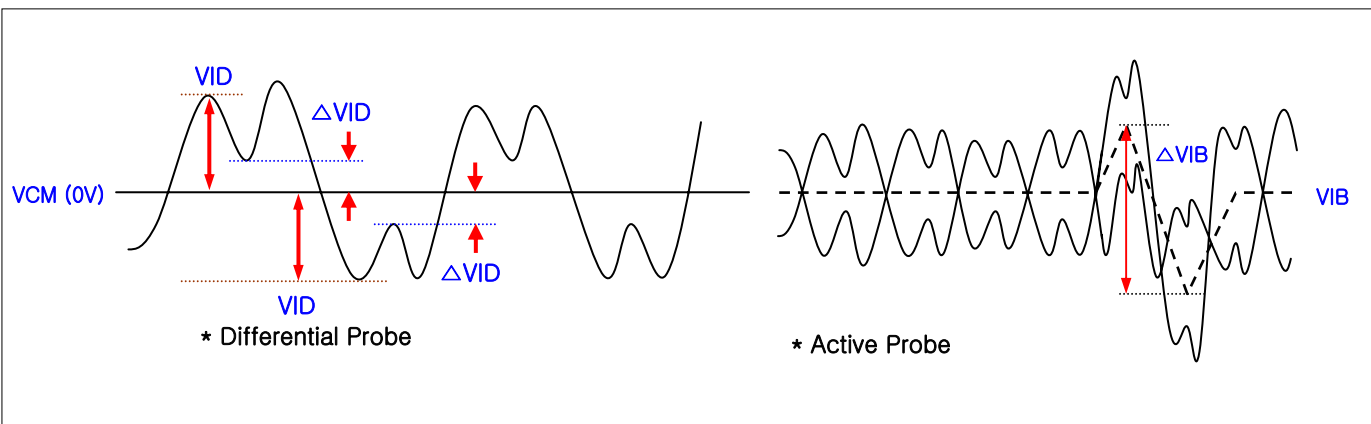


FIG. 2 Description of VID, ΔVID, VIB

* Source PCB

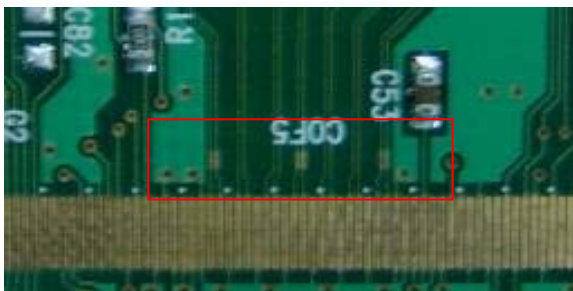


FIG. 3 Measure point

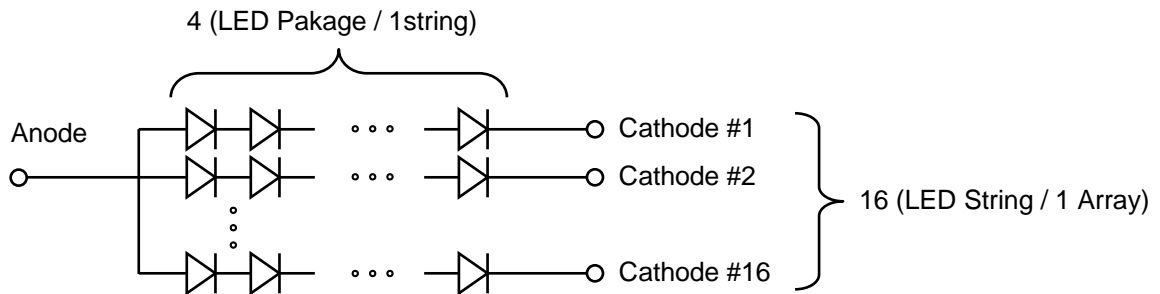
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Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter		Symbol	Values			Unit	Note
			Min	Typ	Max		
Backlight Assembly :							
Forward Current (one array)	Anode	I _{F (anode)}		TBD		mAdc	±5%
	Cathode	I _{F (cathode)}	TBD	95mA[TBD]	TBD	mAdc	2, 3
Forward Voltage		V _F	12.0	12.8	13.6	Vdc	4
Forward Voltage Variation		△V _F			1.2	Vdc	5
Power Consumption		P _{BL}	TBD	TBD	TBD	W	6
Burst Dimming Duty		On duty	TBD		TBD	%	
Burst Dimming Frequency		1/T	TBD		TBD	Hz	8
LED Array : (APPENDIX-V)							
Life Time			30,000			Hrs	7

Notes : The design of the LED driver must have specifications for the LED array in LCD Assembly.
 The electrical characteristics of LED driver are based on Constant Current driving type.
 The performance of the LED in LCM, for example life time or brightness, is extremely influenced by the characteristics of the LED Driver. So, all the parameters of an LED driver should be carefully designed.
 When you design or order the LED driver, please make sure unwanted lighting caused by the mismatch of the LED and the driver (no lighting, flicker, etc) has never been occurred. When you confirm it, the LCD-Assembly should be operated in the same condition as installed in your instrument.

1. Electrical characteristics are based on LED Array specification.
2. Specified values are defined for a Backlight Assembly. (IBL : 10 LED array, 880mA/LED array)
3. Each LED array has 2 anode terminals and 16 cathode terminals.
 The forward current(I_F) of 2 anode terminals is 880mA and it supplies 55mA into 16 blocks, respectively



4. The forward voltage(V_F) of LED array depends on ambient temperature (Appendix-V)
5. ΔV_F means Max V_F -Min V_F in one Backlight. So V_F variation in a Backlight isn't over Max. 1.2V
6. Maximum level of power consumption is measured at initial turn on.
 Typical level of power consumption is measured after 1hrs aging at $25 \pm 2^\circ\text{C}$.
7. The life time(MTTF) is determined as the time at which brightness of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at $25 \pm 2^\circ\text{C}$, based on duty 100%.
8. The reference method of burst dimming duty ratio.
 It is recommended to use synchronous V-sync frequency to prevent waterfall
 ($V_{\text{sync}} \times 1 = \text{Burst Frequency}$)
 Though PWM frequency is over 182Hz (max252Hz), function of backlight is not affected.

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3-2. Interface Connections

This LCD module employs two kinds of interface connection, two 80-pin FFC connector are used for the module electronics and two 100-pin FFC connectors are used for the integral backlight system.

3-2-1. LCD Module

-LCD Connector (CN1): TF06L-80S-0.5SH (Manufactured by Hirose) or Equivalent

Table 4-1. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	VDD	Driver Power Supply Voltage	41	GND	Ground
2	VDD	Driver Power Supply Voltage	42	POL	Polarity Output Signal
3	GND	Ground	43	GSP	Gate Start Pulse
4	VCC	Logic Power Supply Voltage	44	H_CONV	Horizontal 2 Inversion Signal
5	VCC	Logic Power Supply Voltage	45	OPT_N	"H" Normal Display / "L" Rotation Display
6	GND	Ground	46	GND	Ground
7	HVDD	Half Driver Power Supply Voltage	47	LRV5 -	Left Right Mini LVDS Receiver Signal(5-)
8	HVDD	Half Driver Power Supply voltage	48	LRV5 +	Left Right Mini LVDS Receiver Signal(5+)
9	GND	Ground	49	LRV4 -	Left Right Mini LVDS Receiver Signal(4-)
10	VGL	Gate Low Voltage	50	LRV4 +	Left Right Mini LVDS Receiver Signal(4+)
11	GND	Ground	51	LRV3 -	Left Right Mini LVDS Receiver Signal(3-)
12	GOE	Gate Output Enable	52	LRV3 +	Left Right Mini LVDS Receiver Signal(3+)
13	GSC	Gate Shift Clock	53	GND	Ground
14	GND	Ground	54	LRVCLK -	Left Right Mini LVDS Receiver Clock(-)
15	VGH	Gate High Voltage	55	LRVCLK +	Left Right Mini LVDS Receiver Clock(+)
16	GND	Ground	56	GND	Ground
17	LVCOM_FB	Vcom Feedback	57	LRV2 -	Left Right Mini LVDS Receiver Signal(2-)
18	VCOM_L	Left Vcom Output	58	LRV2 +	Left Right Mini LVDS Receiver Signal(2+)
19	GND	Ground	59	LRV1 -	Left Right Mini LVDS Receiver Signal(1-)
20	ZOUT	LTD Output	60	LRV1 +	Left Right Mini LVDS Receiver Signal(1+)
21	GND	Ground	61	LRV0 -	Left Right Mini LVDS Receiver Signal(0-)
22	GND	Ground	62	LRV0 +	Left Right Mini LVDS Receiver Signal(0+)
23	GMA18	Gamma Voltage 18	63	GND	Ground
24	GMA17	Gamma Voltage 17	64	LLV5 -	Left Left Mini LVDS Receiver Signal(5-)
25	GMA16	Gamma Voltage 16	65	LLV5 +	Left Left Mini LVDS Receiver Signal(5+)
26	GMA15	Gamma Voltage 15	66	LLV4 -	Left Left Mini LVDS Receiver Signal(4-)
27	GMA14	Gamma Voltage 14	67	LLV4 +	Left Left Mini LVDS Receiver Signal(4+)
28	GMA13	Gamma Voltage 13	68	LLV3 -	Left Left Mini LVDS Receiver Signal(3-)
29	GMA12	Gamma Voltage 12	69	LLV3 +	Left Left Mini LVDS Receiver Signal(3+)
30	GMA10	Gamma Voltage 10	70	GND	Ground
31	GMA9	Gamma Voltage 9	71	LLVCLK -	Left Left Mini LVDS Receiver Clock(-)
32	GMA7	Gamma Voltage 7	72	LLVCLK +	Left Left Mini LVDS Receiver Clock(+)
33	GMA6	Gamma Voltage 6	73	GND	Ground
34	GMA5	Gamma Voltage 5	74	LLV2 -	Left Left Mini LVDS Receiver Signal(2-)
35	GMA4	Gamma Voltage 4	75	LLV2 +	Left Left Mini LVDS Receiver Signal(2+)
36	GMA3	Gamma Voltage 3	76	LLV1 -	Left Left Mini LVDS Receiver Signal(1-)
37	GMA2	Gamma Voltage 2	77	LLV1 +	Left Left Mini LVDS Receiver Signal(1+)
38	GMA1	Gamma Voltage 1	78	LLV0 -	Left Left Mini LVDS Receiver Signal(0-)
39	GND	Ground	79	LLV0 +	Left Left Mini LVDS Receiver Signal(0+)
40	SOE	Source Output Enable	80	GND	Ground

Note : 1. Please refer to application note (**Half VDD & Gamma Voltage setting**) for details.

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-LCD Connector (CN2): TF06L-80S-0.5SH (Manufactured by Hirose) or Equivalent

Table 4-2. MODULE CONNECTOR(CN2) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	GND	Ground	41	GSP	Gate Start Pulse
2	RRV5 -	Right Right Mini LVDS Receiver Signal(5-)	42	GND	Ground
3	RRV5 +	Right Right Mini LVDS Receiver Signal(5+)	43	GMA 18	Gamma Voltage 18
4	RRV4 -	Right Right Mini LVDS Receiver Signal(4-)	44	GMA 17	Gamma Voltage 17
5	RRV4 +	Right Right Mini LVDS Receiver Signal(4+)	45	GMA 16	Gamma Voltage 16
6	RRV3 -	Right Right Mini LVDS Receiver Signal(3-)	46	GMA 15	Gamma Voltage 15
7	RRV3 +	Right Right Mini LVDS Receiver Signal(3+)	47	GMA 14	Gamma Voltage 14
8	GND	Ground	48	GMA 13	Gamma Voltage 13
9	RRVCLK -	Right Right Mini LVDS Receiver Clock(-)	49	GMA 12	Gamma Voltage 12
10	RRVCLK +	Right Right Mini LVDS Receiver Clock(+)	50	GMA 10	Gamma Voltage 10
11	GND	Ground	51	GMA 9	Gamma Voltage 9
12	RRV2 -	Right Right Mini LVDS Receiver Signal(2-)	52	GMA 7	Gamma Voltage 7
13	RRV2 +	Right Right Mini LVDS Receiver Signal(2+)	53	GMA 6	Gamma Voltage 6
14	RRV1 -	Right Right Mini LVDS Receiver Signal(1-)	54	GMA 5	Gamma Voltage 5
15	RRV1 +	Right Right Mini LVDS Receiver Signal(1+)	55	GMA 4	Gamma Voltage 4
16	RRV0 -	Right Right Mini LVDS Receiver Signal(0-)	56	GMA 3	Gamma Voltage 3
17	RRV0 +	Right Right Mini LVDS Receiver Signal(0+)	57	GMA 2	Gamma Voltage 2
18	GND	Ground	58	GMA 1	Gamma Voltage 1
19	RLV5 -	Right Left Mini LVDS Receiver Signal(5-)	59	GND	Ground
20	RLV5 +	Right Left Mini LVDS Receiver Signal(5+)	60	ZOUT	LTD Output
21	RLV4 -	Right Left Mini LVDS Receiver Signal(4-)	61	GND	Ground
22	RLV4 +	Right Left Mini LVDS Receiver Signal(4+)	62	VCOM_R	Right Vcom Output
23	RLV3 -	Right Left Mini LVDS Receiver Signal(3-)	63	RVCOM_FB	NC(TBD)
24	RLV3 +	Right Left Mini LVDS Receiver Signal(3+)	64	GND	Ground
25	GND	Ground	65	VGH	Gate High Voltage
26	RLVCLK -	Right Left Mini LVDS Receiver Clock(-)	66	GND	Ground
27	RLVCLK +	Right Left Mini LVDS Receiver Clock(+)	67	GSC	Gate Shift Clock
28	GND	Ground	68	GOE	Gate Output Enable
29	RLV2 -	Right Left Mini LVDS Receiver Signal(2-)	69	GND	Ground
30	RLV2 +	Right Left Mini LVDS Receiver Signal(2+)	70	VGL	Gate Low Voltage
31	RLV1 -	Right Left Mini LVDS Receiver Signal(1-)	71	OPT_P	"L" Normal Display / "H" Rotation Display
32	RLV1 +	Right Left Mini LVDS Receiver Signal(1+)	72	GND	Ground
33	RLV0 -	Right Left Mini LVDS Receiver Signal(0-)	73	HVDD	Half Driver Power Supply Voltage
34	RLV0 +	Right Left Mini LVDS Receiver Signal(0+)	74	HVDD	Half Driver Power Supply voltage
35	GND	Ground	75	GND	Ground
36	OPT_N	"H" Normal Display / "L" Rotation Display	76	VCC	Logic Power Supply Voltage
37	H_CONV	Horizontal 2 Inversion Signal	77	VCC	Logic Power Supply Voltage
38	SOE	Source Output Enable	78	GND	Ground
39	GND	Ground	79	VDD	Driver Power Supply Voltage
40	POL	Polarity Output Signal	80	VDD	Driver Power Supply Voltage

Note : 1. Please refer to application note (**Half VDD & Gamma Voltage setting**) for details.



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3-2-2. Backlight Module

[CN1]

1) LED Array assy Connector (Receptacle)

: 05002HR-100G3 (manufactured by Yeonho) or equivalent

[CN2]

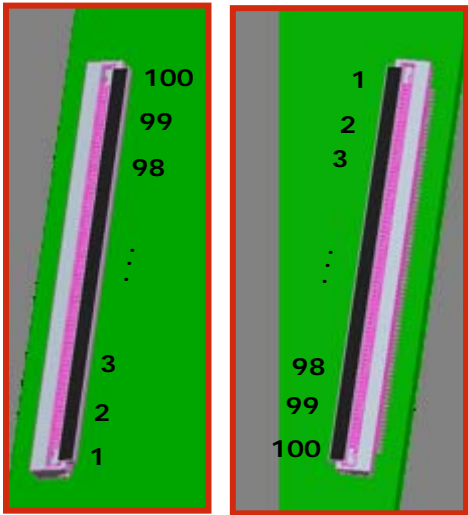
1) LED Array assy Connector (Receptacle)

: 05002HR-100G3 (manufactured by Yeonho) or equivalent

Table 5. BACKLIGHT CONNECTOR PIN CONFIGURATION(CN1,CN2)

No	Symbol	Description	Note	No	Symbol	Description	Note
1~9	#1 Anode	LED Input Current		1~9	#3 Anode	LED Input Current	
10	N.C	Open		10	N.C	Open	
11~90	Cathode	LED Output Current	Appendix-V	11~90	Cathode	LED Output Current	Appendix-V
91	N.C	Open		91	N.C	Open	
92~100	#2 Anode	LED Input Current		92~100	#4 Anode	LED Input Current	

◆ Rear view of LCM



[CN1]

[CN2]

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3-3. Signal Timing Specifications

Table 6. Timing Requirements

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
Mini Clock pulse period	T1		3.2	3.4		ns	1
Mini Clock pulse low period	T2		1.6	–	–	ns	
Mini Clock pulse high period	T3		1.6	–	–	ns	
Mini Data setup time	T6		0.6	–	–	ns	
Mini Data hold time	T7		0.6	–	–	ns	
Reset low to SOE rising time	T8		0	–	–	ns	
SOE to Reset input time	T9		200	–	–	ns	
Receiver off to SOE timing	T10		10	–	–	CLK cycle	
POL signal to SOE setup time	T11		–5	–	–	ns	
POL signal to SOE hold time	T12		6	–	–	ns	
Reset High Period	T13		3			CLK cycle	
SOE signal GSP setup time	T14		100			ns	
SOE signal GSP Hold time	T15		100			ns	
SOE signal Pulse Width	T16		200			ns	

- Note :**
1. Mini-LVDS timing measure conditions
: 268MHz < Clock Frequency < 312MHz , 150mV < VID < 800mV @ 3.0<VCC<3.3
 2. Setup time and hold time couldn't be satisfied at the same time

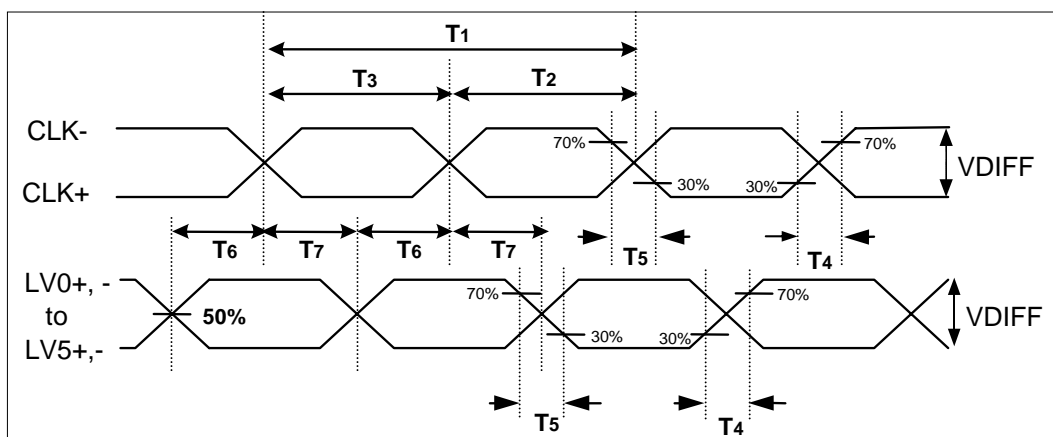


FIG 4. Source D-IC Input Data Latch Timing Waveform

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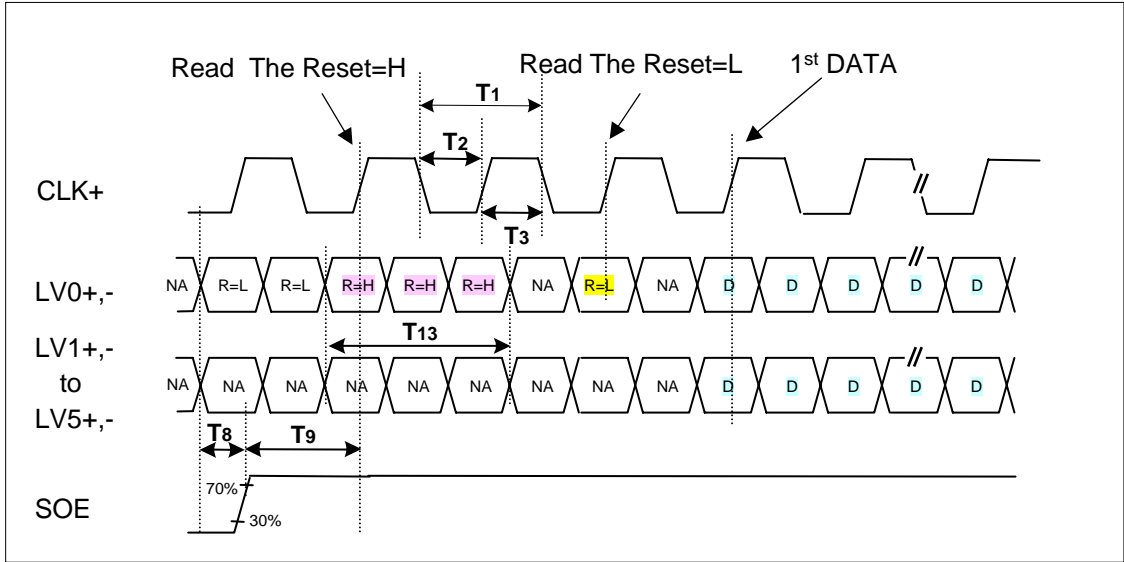


FIG 5-1. Input Data Timing for 1st Source D-IC Chip

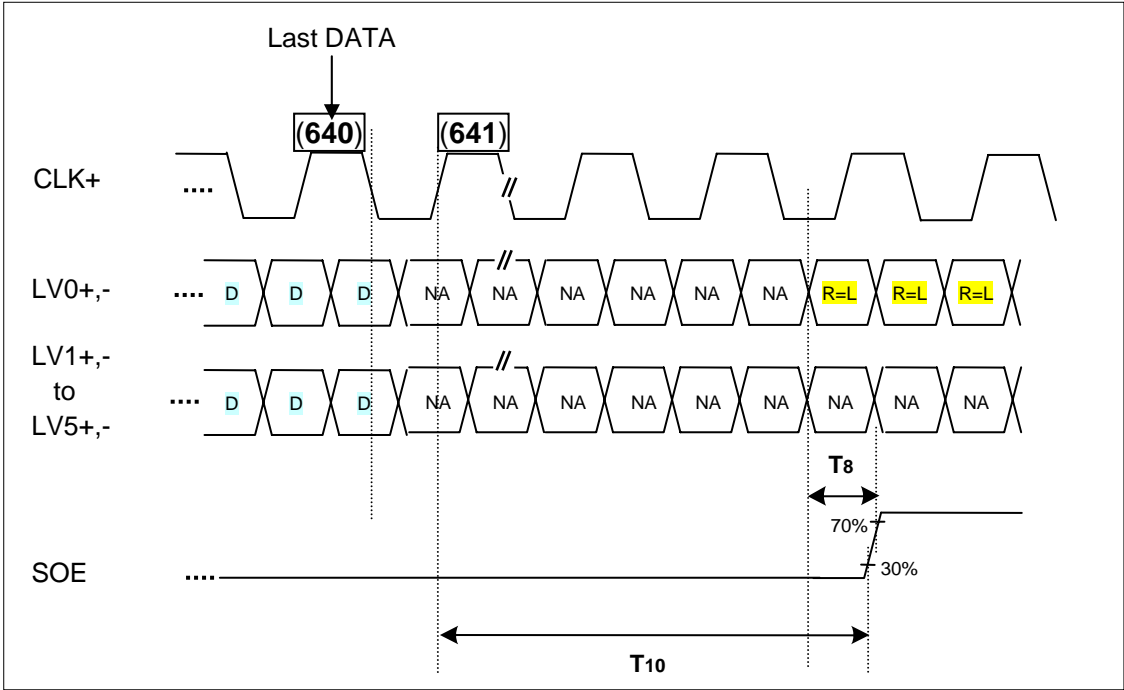


FIG 5-2. Last Data Latch to SOE Timing

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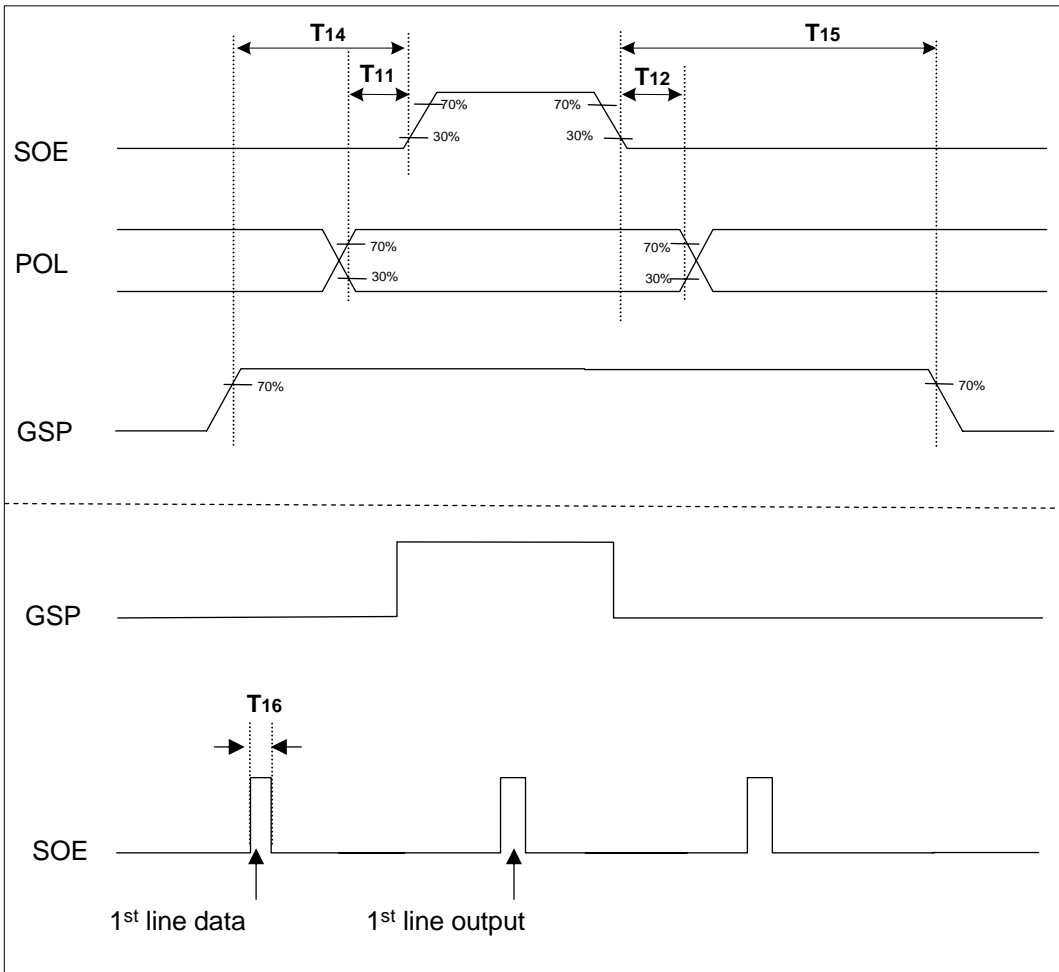
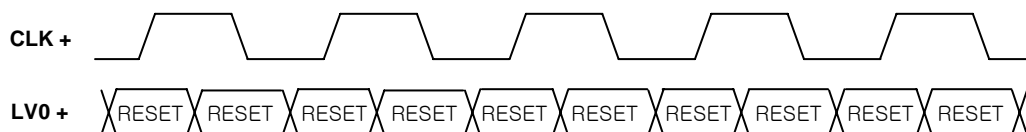


FIG 6. POL, GSP and SOE Timing Waveform

3-4. Data Mapping and Timing

Display data and control signal (RESET) are input to **LV0** to **LV5**.

3-4-1. Control signal input mode



3-4-2. Display data input mode

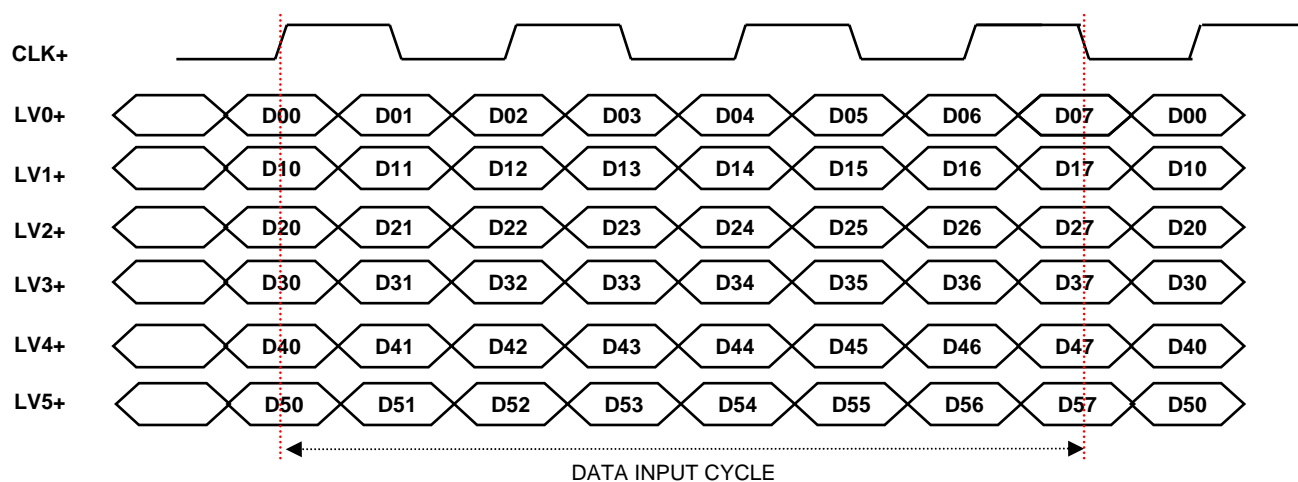


Fig. 7 Mini-LVDS Data

Note : 1. For data mapping, please refer to panel pixel structure Fig.8

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3-5. Panel Pixel Structure

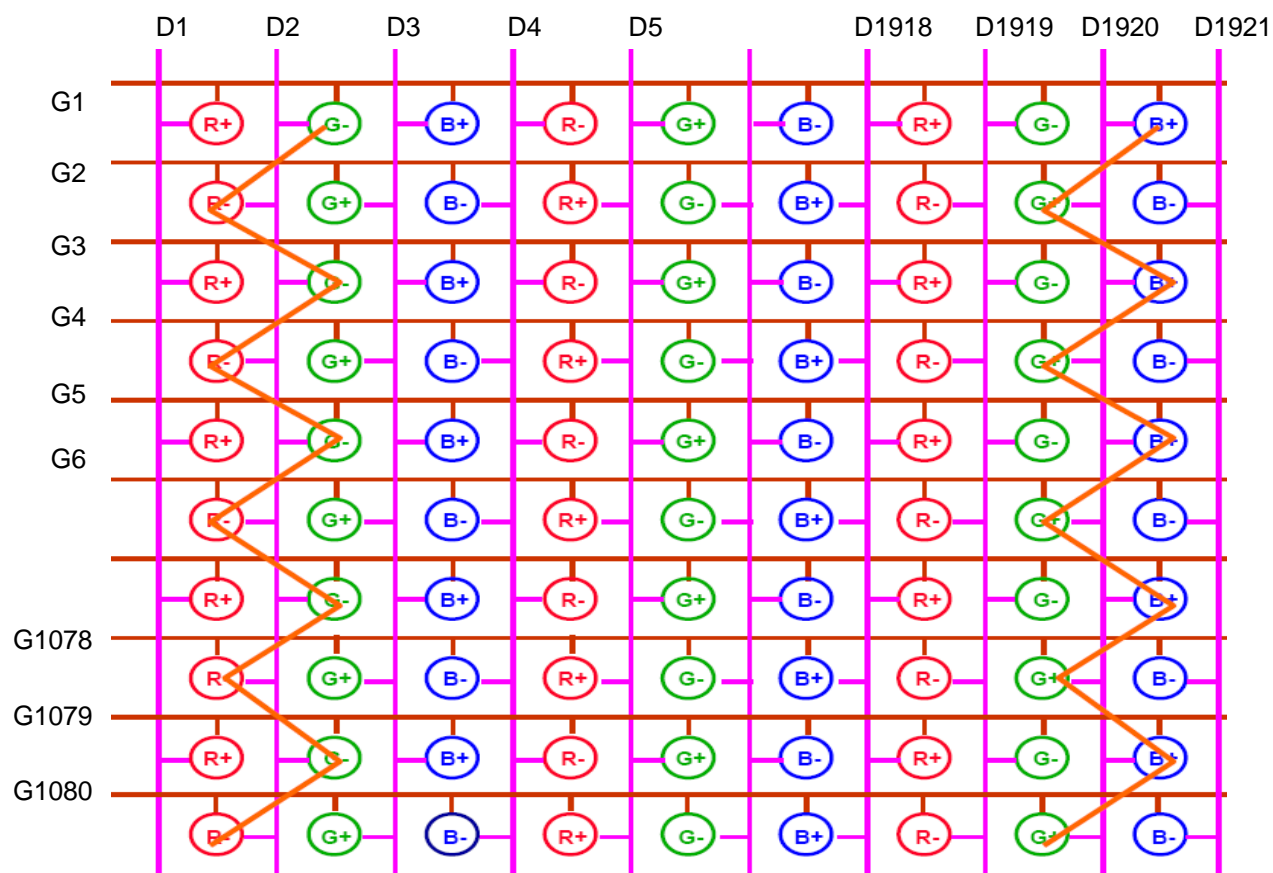


FIG. 8 Panel Pixel Structure

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3-6. Power Sequence

3-6-1. LCD Driving circuit

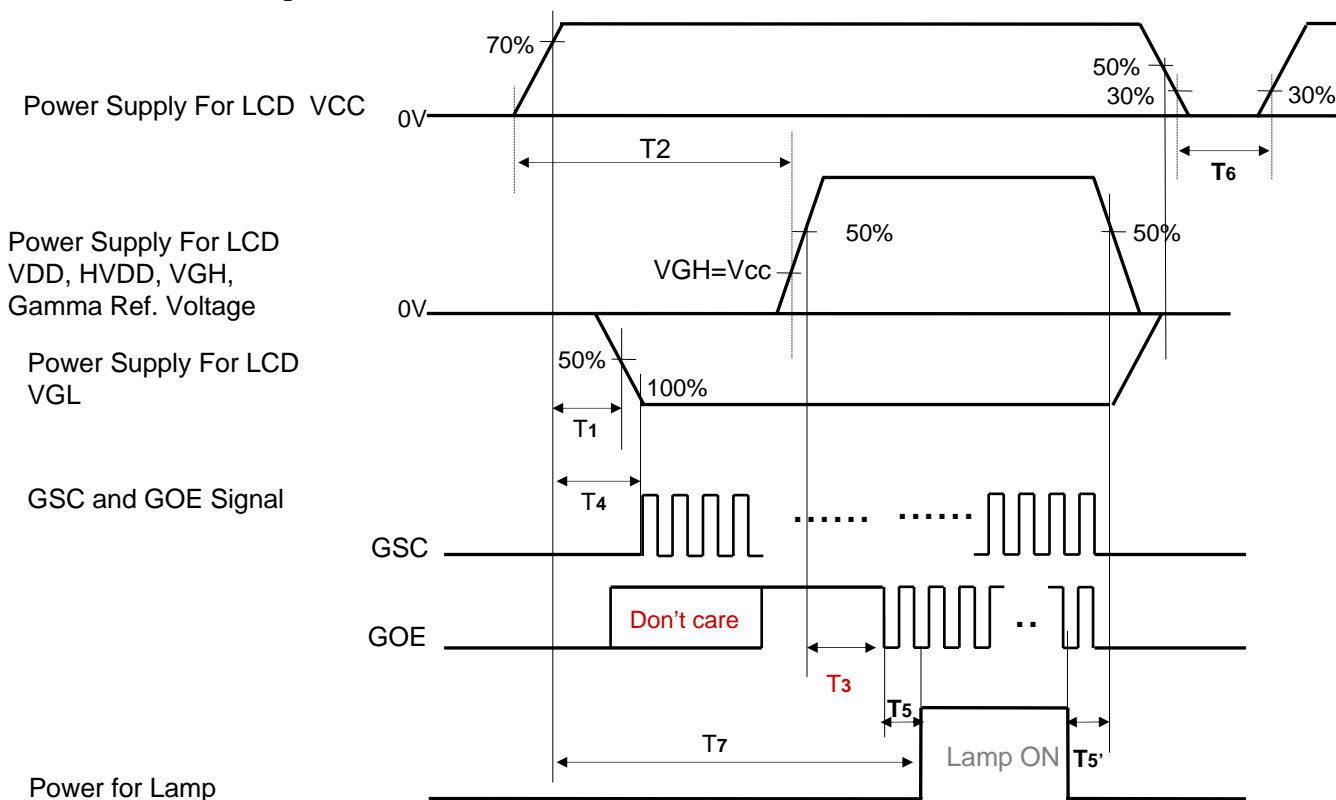


Table 7. POWER SEQUENCE

Ta = 25±2°C, fv=240Hz, Dclk=297MHz

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	0.5		–	ms	
T2	0.01		–	ms	
T3	20(1~2frame)		–	ms	
T4	0		T2	ms	
T5 / T5'	20(1~2frame)		–	ms	
T6	2		–	sec	
T7	0.5		–	s	

- Note :
1. Power sequence for Source D-IC must be kept. ※ Please refer to Appendix IV for more details
 2. The Gate D-IC power on sequence must be VCC, VGL, logic input & VGH.
 4. The 1st start of GSC is located between VGL and VGH.
 5. GOE rising is before GSC.
 6. Power off sequence order is reverse of power on sequence.

Product Specification

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at $25 \pm 2^\circ\text{C}$. The values are specified at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0° .

It is presented additional information concerning the measurement equipment and method in FIG. 9.

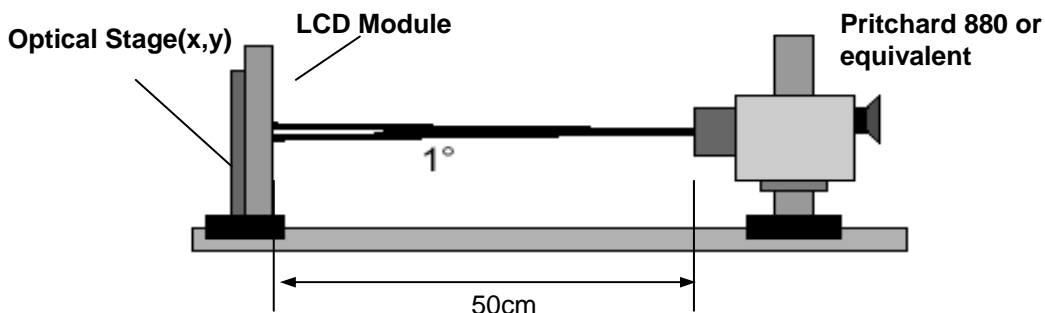


FIG. 9 Optical Characteristic Measurement Equipment and Method

$T_a = 25 \pm 2^\circ\text{C}$, $V_{\text{LCD}} = 12.0\text{V}$, $f_v = 240\text{Hz}$, $D_{\text{clk}} = 297\text{MHz}$,

Table 8. OPTICAL CHARACTERISTICS

Parameter		Symbol		Value			Unit	Note
				Min	Typ	Max		
Contrast Ratio		CR		900	1300	–		1
Surface Luminance, white		L _{WH}		400	500	–	cd/m²	2
Luminance Variation		δ _{WHITE}	5P	–	–	1.3		3
Response Time	Rising	Tr		–	4(TBD)		ms	4
	Falling	Tf		–	4(TBD)			
Color Coordinates [CIE1931]	RED	Rx		Typ –0.03	0.652(TBD)	Typ +0.03		
		Ry			0.330(TBD)			
	GREEN	Gx			0.305(TBD)			
		Gy			0.597(TBD)			
	BLUE	Bx			0.149(TBD)			
		By			0.060(TBD)			
	WHITE	Wx			0.279(TBD)			
		Wy			0.292(TBD)			
Color Temperature					10,000		K	
Color Gamut					72		%	
Viewing Angle (CR>10)								
	x axis, right(φ=0°)	θr		89	–	–	degree	5
	x axis, left (φ=180°)	θl		89	–	–		
	y axis, up (φ=90°)	θu		89	–	–		
	y axis, down (φ=270°)	θd		89	–	–		
Gray Scale				–	–	–		6

Product Specification

Note : 1. Contrast Ratio(CR) is defined mathematically as :

$$CR = \frac{\text{Surface Luminance at all white pixels}}{\text{Surface Luminance at all black pixels}}$$

It is measured at center 1-point

2. Surface luminance is determined after the unit has been 'ON' and 1Hour after lighting the backlight in a dark environment at $25 \pm 2^\circ\text{C}$. Surface luminance is the luminance value at center 1-point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see the FIG. 10.
3. The variation in surface luminance, δ WHITE is defined as :
 $\delta \text{ WHITE}(5P) = \text{Maximum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5}) / \text{Minimum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5})$
 Where L_{on1} to L_{on5} are the luminance with all pixels displaying white at 5 locations .
 For more information, see the FIG. 10.
4. Response time is the time required for the display to transit from G(255) to G(0) (Rise Time, Tr_R) and from G(0) to G(255) (Decay Time, Tr_D).
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD module surface. For more information, see the FIG. 12.
6. Gray scale specification
 Gamma Value is approximately 2.2. For more information, see the Table 9.

Table 9. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ)
L0	0.07
L15	0.24
L31	1.04
L47	2.49
L63	4.68
L79	7.66
L95	11.5
L111	16.1
L127	21.6
L143	28.1
L159	35.4
L175	43.7
L191	53.0
L207	63.2
L223	74.5
L239	86.7
L255	100

	Gray Level	Gamma Ref.
Positive Voltage	L0	Gamma9
	L1	Gamma8
	L31	Gamma7
	L63	Gamma6
	L127	Gamma5
	L191	Gamma4
	L223	Gamma3
	L255	Gamma1
Negative Voltage	L255	Gamma18
	L223	Gamma16
	L191	Gamma15
	L127	Gamma14
	L63	Gamma13
	L31	Gamma12
	L1	Gamma11
	L0	Gamma10

Product Specification

Measuring point for surface luminance & luminance variation

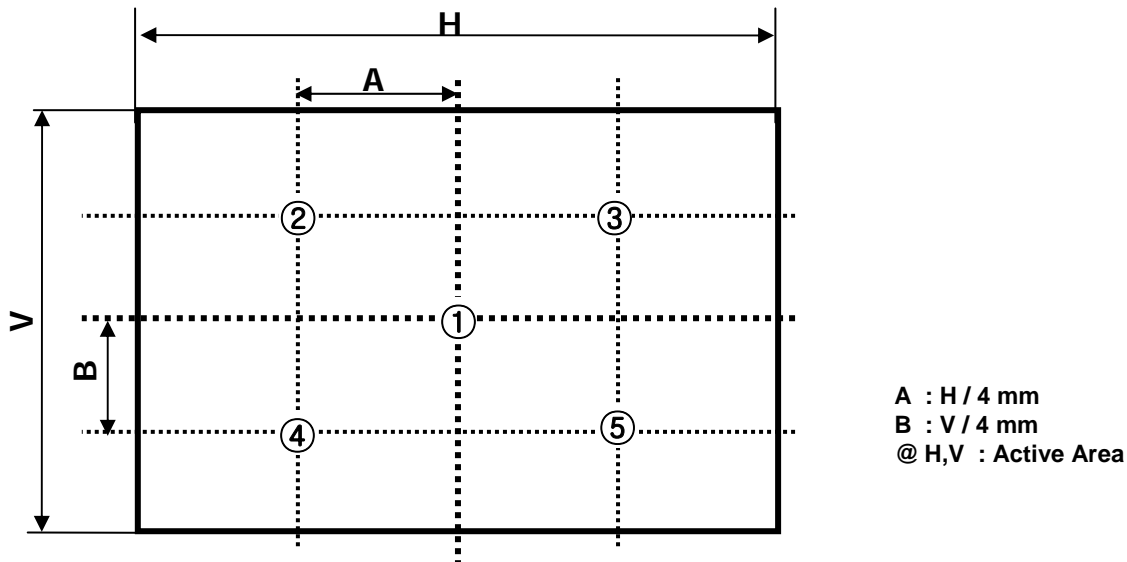


FIG. 10 5 Points for Luminance Measure

Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".

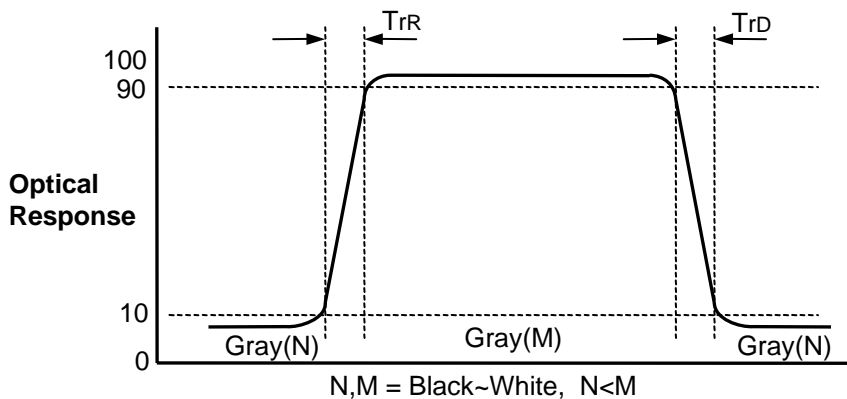


FIG. 11 Response Time

Product Specification

Dimension of viewing angle range

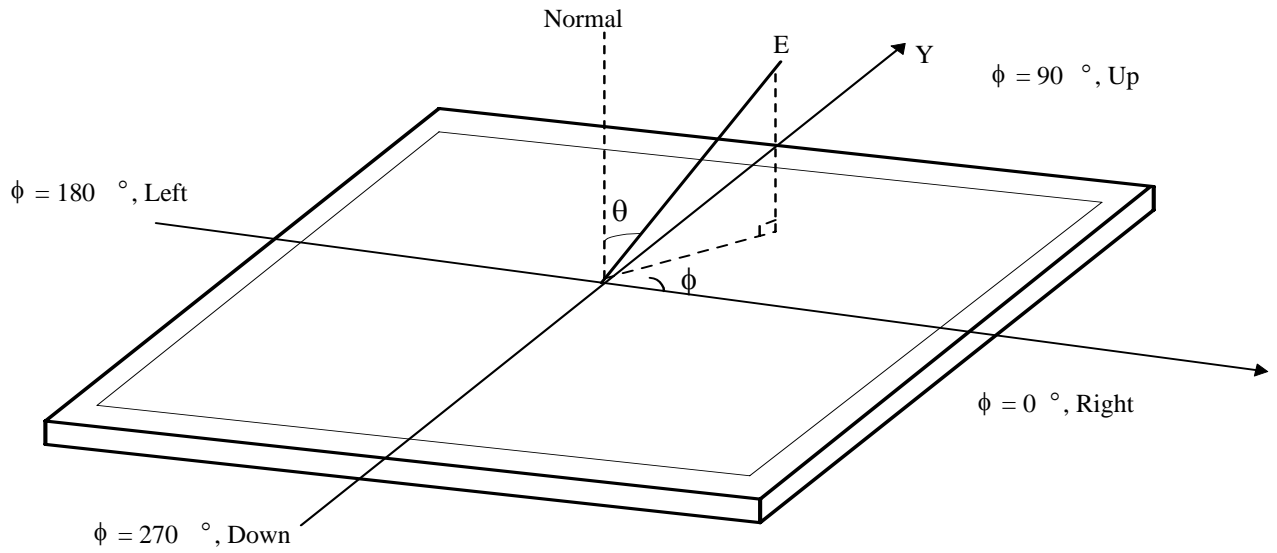


FIG.12 Viewing Angle

Product Specification

5. Mechanical Characteristics

Table 10 provides general mechanical characteristics.

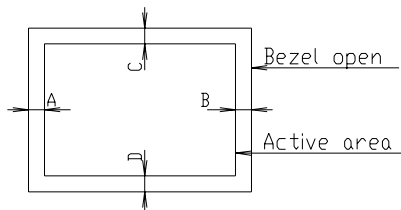
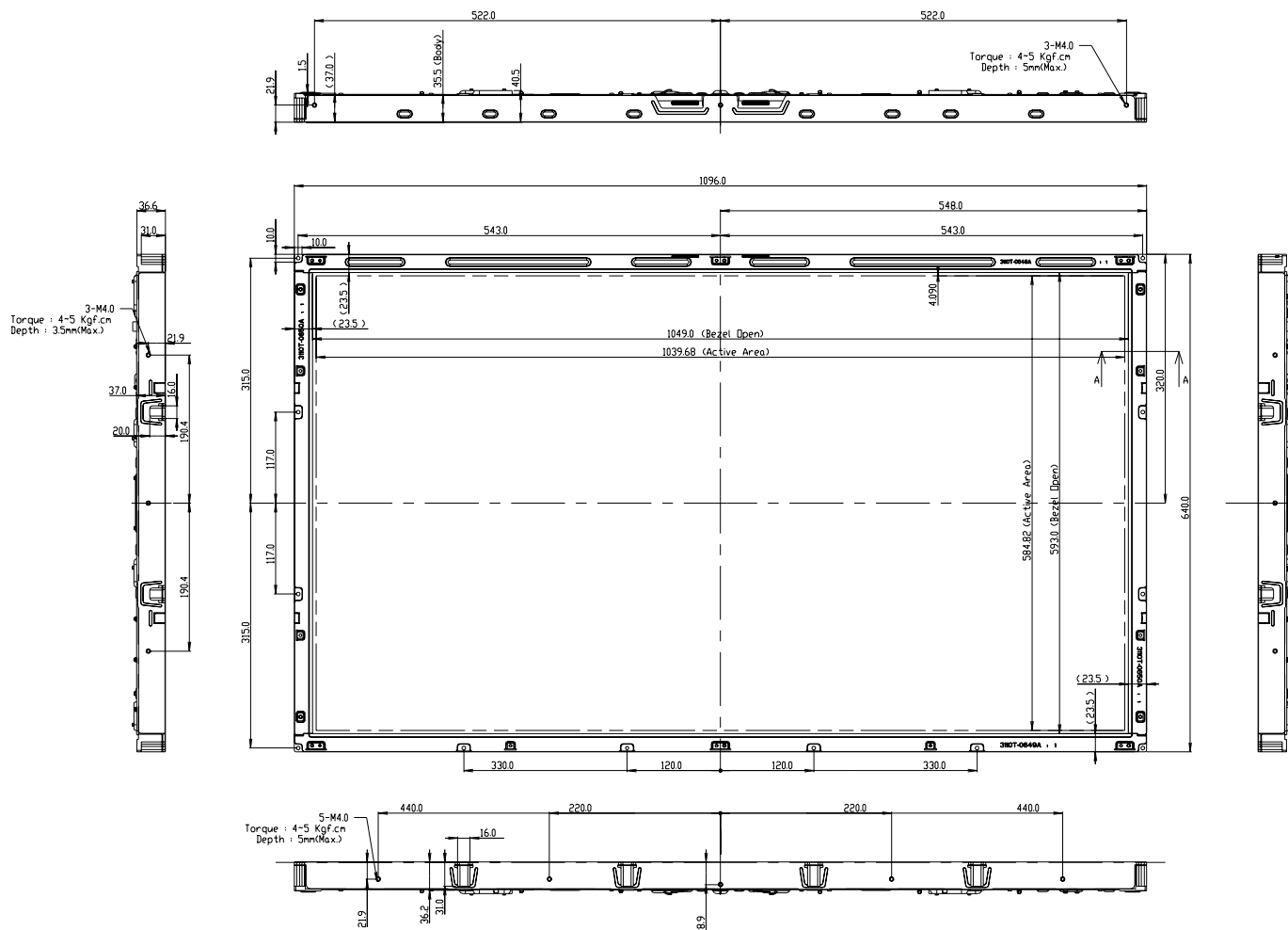
Table 10. MECHANICAL CHARACTERISTICS

Item	Value	
Outline Dimension	Horizontal	1096.0 mm
	Vertical	640.0 mm
	Depth	35.5 mm
Bezel Area	Horizontal	1049.0 mm
	Vertical	593.0 mm
Active Display Area	Horizontal	1039.68 mm
	Vertical	584.82 mm
Weight	13 Kg (Typ.) , 14Kg (Max.)	

Note : Please refer to a mechanical drawing in terms of tolerance at the next page.

Product Specification

[FRONT VIEW]



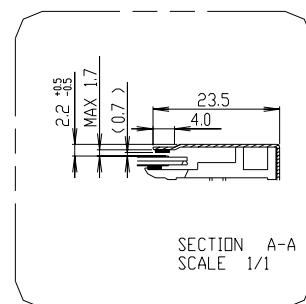
NOTES

1. Unspecified tolerances are to be $\pm 1.0\text{mm}$.

2. Tilt and partial disposition tolerance of display area are as following.

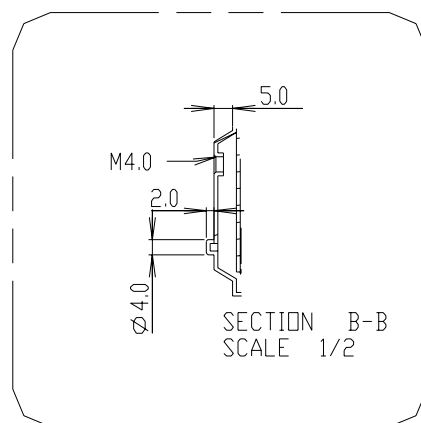
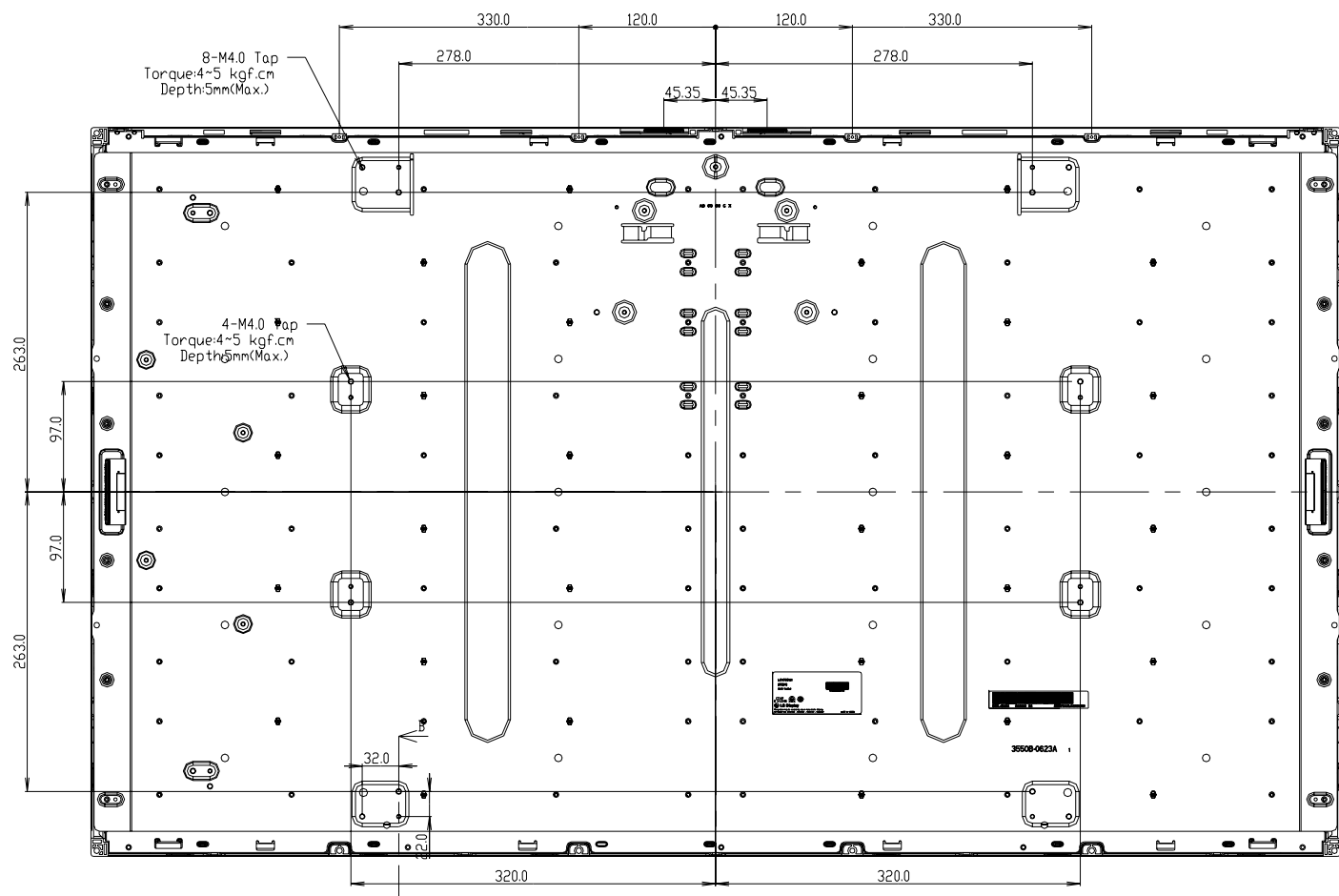
(1) X-Direction : IA-BI 1.5mm

(2) Y-Direction : IC-DI 1.5mm



Product Specification

[REAR VIEW]



Product Specification

6. Reliability

Table 11. ENVIRONMENT TEST CONDITION

No.	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0Grms Bandwidth : 10-300Hz Duration : X,Y,Z, 30 min Each direction per 10 min
6	Shock test (non-operating)	Shock level : 50Grms Waveform : half sine wave, 11ms Direction : $\pm X$, $\pm Y$, $\pm Z$ One time each direction
7	Humidity condition Operation	Ta= 40 °C ,90%RH
8	Altitude operating storage / shipment	0 - 15,000 ft 0 - 40,000 ft

Note : Before and after Reliability test, LCM should be operated with normal function.

Product Specification

7. International Standards

7-1. Safety

- a) UL 60065, Seventh Edition, Underwriters Laboratories Inc.
Audio, Video and Similar Electronic Apparatus - Safety Requirements.
- b) CAN/CSA C22.2 No.60065:03, Canadian Standards Association.
Audio, Video and Similar Electronic Apparatus - Safety Requirements.
- c) EN 60065:2002 + A11:2008, European Committee for Electrotechnical Standardization (CENELEC).
Audio, Video and Similar Electronic Apparatus - Safety Requirements.
- d) IEC 60065:2005 + A1:2005, The International Electrotechnical Commission (IEC).
Audio, Video and Similar Electronic Apparatus - Safety Requirements.
(Including report of IEC60825-1:2001 clause 8 and clause 9)

Notes

1. Laser (LED Backlight) Information

Class 1M LED Product IEC60825-1 : 2001 Embedded LED Power (Class1M) Power : 1.8163 mW (Max.) Wavelength : 279 ~605 (nm) Width : 0.6 x 0.6 (mm)

2. Caution

: LED inside.

Class 1M laser (LEDs) radiation when open.

Do not open while operating.

7-2. Environment

- a) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment

Product Specification

8. Packing**8-1. Information of LCM Label**

a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M
---	---	---	---	---	---	---	---	---	---	---	---	---

A,B,C : SIZE(INCH)
E : MONTH

D : YEAR
F ~ M : SERIAL NO.

Note

1. YEAR

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mark	1	2	3	4	5	6	7	8	9	0

2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	4	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

Serial NO. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one Pallet : 12 pcs

b) Pallet Size : 1300 mm X 1140 mm X 120 mm.

Product Specification

9. Precautions

Please pay attention to the followings when you use this TFT LCD module.

9-1. Mounting Precautions

- (1) You must mount a module using specified mounting holes (Details refer to the drawings).
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

9-2. Operating Precautions

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
 $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
- (7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
- (8) A screw which is fastened up the steels should be a machine screw.
(if not, it can causes conductive particles and deal LCM a fatal blow)
- (9) Please do not set LCD on its edge.
- (10) The conductive material and signal cables are kept away from LED driver inductor to prevent abnormal display, sound noise and temperature rising.

9-3. Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

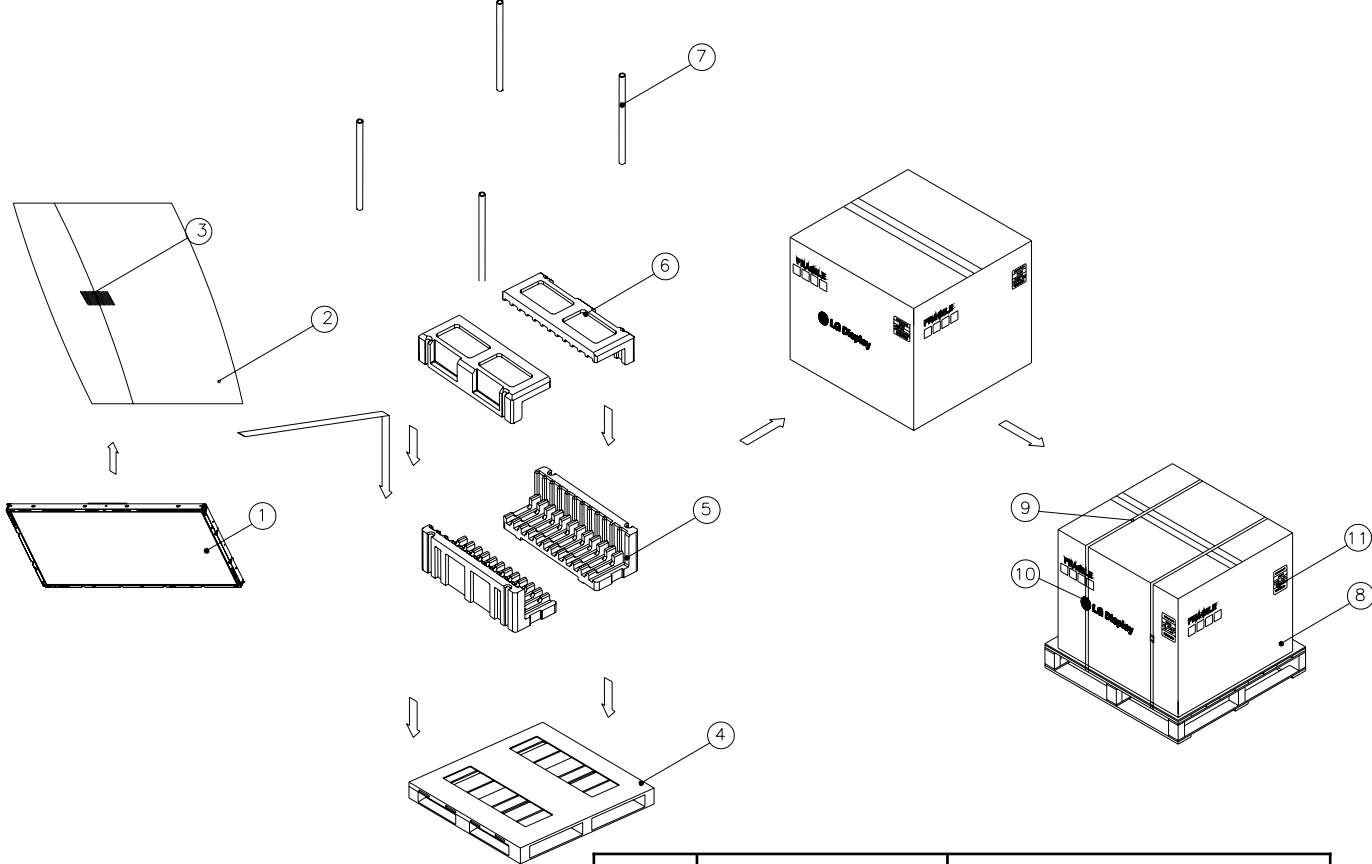
9-6. Handling Precautions for Protection Film

- (1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer.
This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

Product Specification

APPENDIX-I

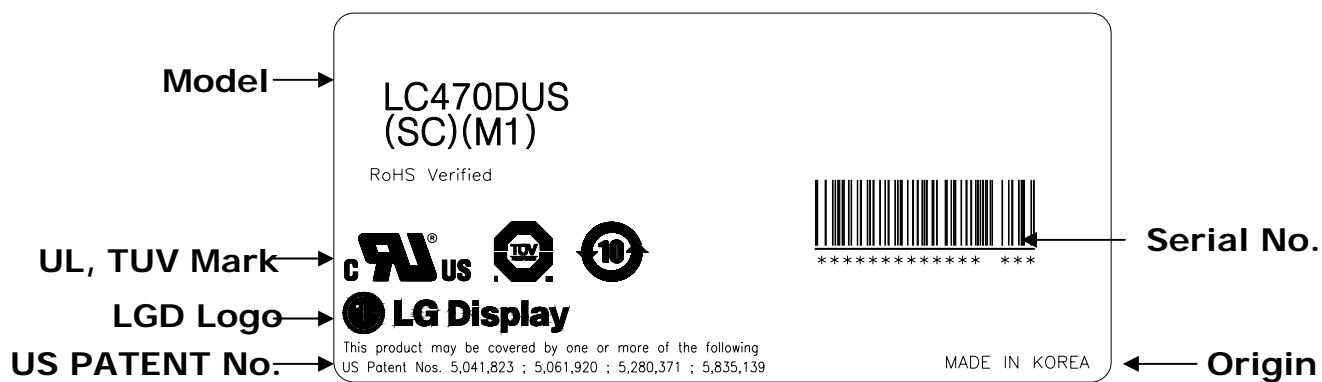
■ LC470DUS-SCM1 – Pallet Ass'y



NO.	DESCRIPTION	MATERIAL
1	LCD Module	
2	BAG	AL
3	TAPE	OPP
4	PALLET	PLYWOOD
5	PACKING	EPS
6	PACKING	EPS
7	ANGLE PACKING	PAPER
8	ANGLE COVER	PAPER
9	BAND,CLIP	STEEL
10	BAND	PP
11	LABEL	YUPO PAPER 80G 100X100

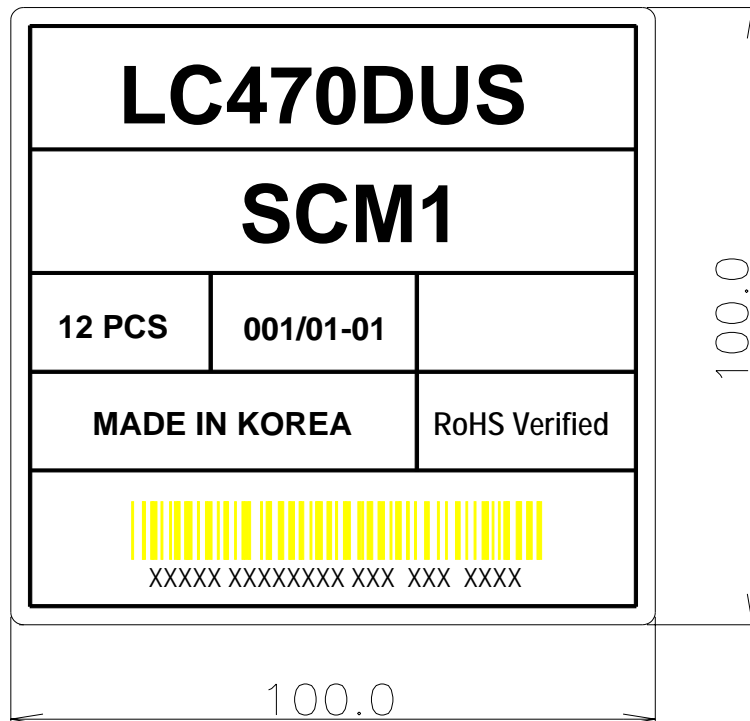
APPENDIX- II-1

■ LC470DUS-SCM1-LCM Label



APPENDIX- II-2

■ LC470DUS-SCM1-Pallet Label

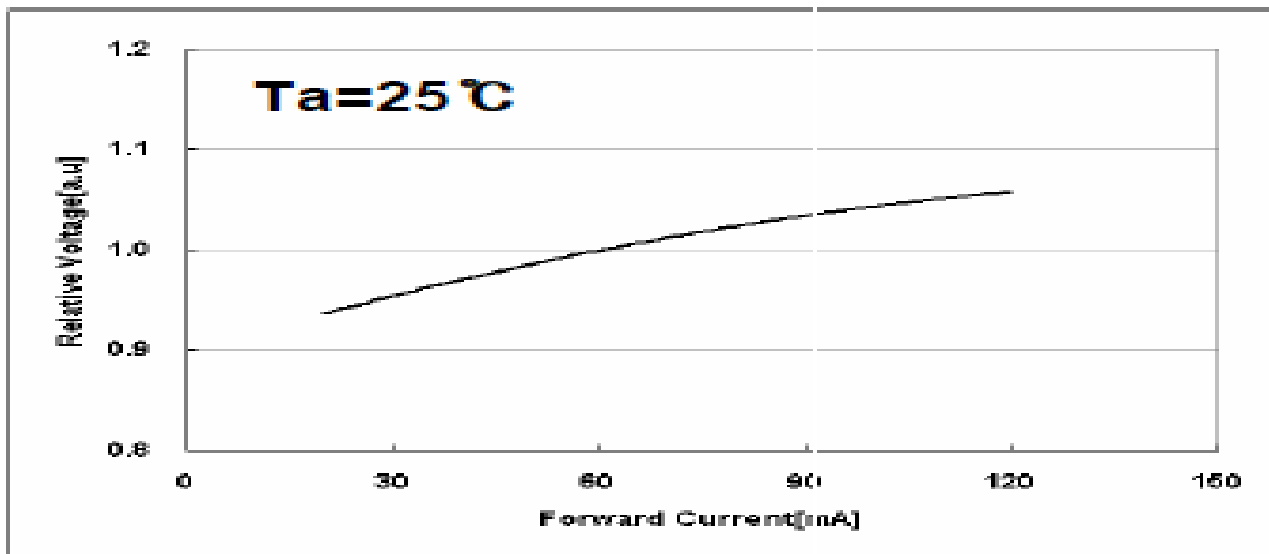


APPENDIX-III

■ LED Array Electrical Spec

[TBD]

■ Forward Current vs. Forward Voltage



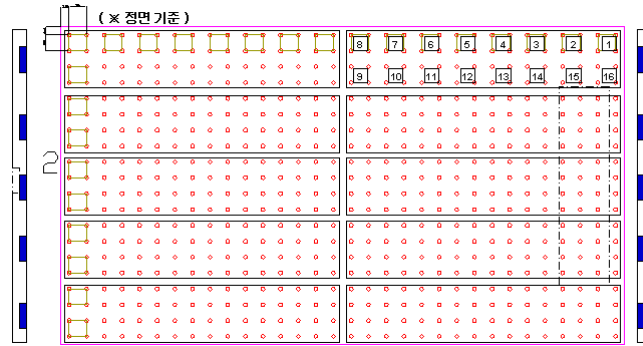
Product Specification

APPENDIX- IV

■ Local Dimming Block Pin Matching

[CN2]

Pin No	Block	Pin No	Block
1	Vo_3	51	F8
2	Vo_3	52	F7
3	Vo_3	53	F6
4	Vo_3	54	F5
5	Vo_3	55	F4
6	Vo_3	56	F3
7	Vo_3	57	F2
8	Vo_3	58	F1
9	Vo_3	59	G1
10	N.C	60	G2
11	A1	61	G3
12	A2	62	G4
13	A3	63	G5
14	A4	64	G6
15	A5	65	G7
16	A6	66	G8
17	A7	67	H8
18	A8	68	H7
19	B8	69	H6
20	B7	70	H5
21	B6	71	H4
22	B5	72	H3
23	B4	73	H2
24	B3	74	H1
25	B2	75	I1
26	B1	76	I2
27	C1	77	I3
28	C2	78	I4
29	C3	79	I5
30	C4	80	I6
31	C5	81	I7
32	C6	82	I8
33	C7	83	J8
34	C8	84	J7
35	D8	85	J6
36	D7	86	J5
37	D6	87	J4
38	D5	88	J3
39	D4	89	J2
40	D3	90	J1
41	D2	91	N.C
42	D1	92	Vo_4
43	E1	93	Vo_4
44	E2	94	Vo_4
45	E3	95	Vo_4
46	E4	96	Vo_4
47	E5	97	Vo_4
48	E6	98	Vo_4
49	E7	99	Vo_4
50	E8	100	Vo_4



Front

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
B	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
C	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
D	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16
E	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16
F	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
G	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16
H	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16
I	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16
J	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16

[CN1]

Pin No	Block	Pin No	Block
100	Vo_2	50	F9
99	Vo_2	49	F10
98	Vo_2	48	F11
97	Vo_2	47	F12
96	Vo_2	46	F13
95	Vo_2	45	F14
94	Vo_2	44	F15
93	Vo_2	43	F16
92	Vo_2	42	G16
91	N.C	41	G15
90	A16	40	G14
89	A15	39	G13
88	A14	38	G12
87	A13	37	G11
86	A12	36	G10
85	A11	35	G9
84	A10	34	H9
83	A9	33	H10
82	B9	32	H11
81	B10	31	H12
80	B11	30	H13
79	B12	29	H14
78	B13	28	H15
77	B14	27	H16
76	B15	26	I16
75	B16	25	I15
74	C16	24	I14
73	C15	23	I13
72	C14	22	I12
71	C13	21	I11
70	C12	20	I10
69	C11	19	I9
68	C10	18	J9
67	C9	17	J10
66	D9	16	J11
65	D10	15	J12
64	D11	14	J13
63	D12	13	J14
62	D13	12	J15
61	D14	11	J16
60	D15	10	N.C
59	D16	9	Vo_1
58	E16	8	Vo_1
57	E15	7	Vo_1
56	E14	6	Vo_1
55	E13	5	Vo_1
54	E12	4	Vo_1
53	E11	3	Vo_1
52	E10	2	Vo_1
51	E9	1	Vo_1

APPENDIX- V

■ LC470DUS-SCM1-Source D-IC Power Sequence

